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RELIABILITY RECORD FOR 6000-POUND GASOLINE-ENGINE-DRIVEN FORK-LIFT TRUCK

January 1971

U. S. ARMY MOBILITY EQUIPMENT COMMAND
4300 GOODFELLOW BOULEVARD
ST. LOUIS, MISSOURI 63120

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RELIABILITY RECORD
FOR 6000-POUND GASOLINE-ENGINE-DRIVEN
FORK-LIFT TRUCK

Prepared in accordance with AMCR 702-8

for U.S. Army Mobility Equipment Command
4300 Goodfellow Boulevard
St. Louis, Missouri 63120

under Contract DAAK01-70-D-4142

January 1971

ARINC Research Corporation
a Subsidiary of Aeronautical Radio, Inc.
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Annapolis, Maryland 21401

Publication B01-01-3-1097

NOTE

This Record is made up of two parts, A and B. Part A presents background and procedures used for compiling the reliability record for the 6000-pound gasoline-engine-driven fork-lift truck; Part B is the Reliability Status Report for the truck.

Prepared under Contract DAAK01-70-D-4142 which grants to the U.S. Government a license to use any material in this publication for Government purposes.

FOREWORD

This document is one of three prepared under Contract DAAK01-70-D-4142, Delivery Order 0001:

Reliability Record for 6000-Pound Gasoline-Engine-Driven Fork-Lift Truck

Reliability Record for Gasoline-Engine-Driven Fork-Lift Truck Family

Failure Modes and Effects Analysis for Gasoline-Engine-Driven Fork-Lift Truck Family

These reports were the result of a six-month review and evaluation of fork-lift truck operation, including data collection and analysis.

CONTENTS

PART A

BACKGROUND AND PROCEDURES

1. PURPOSE

This record is a compilation of reliability information pertaining to the 6000-pound gasoline-engine-driven forklift truck and its subsystems and major components. The vehicle is used in warehousing operations and is described generally by the nomenclature Army Model MHE-193 (FSN 3930-738-5938). The record serves as the primary management-control tool for the truck's reliability.

2. SCOPE

Part A of the reliability record includes:

- A general description of the 6000-pound gasoline-engine-driven fork-lift truck
- A general profile of functions that must be performed by the truck and its systems
- A description of a typical mission for the truck, indicating the percentages of time the various systems function during the mission
- A definition of "failure" in terms of its effects on the accomplishment of the mission
- A list of documents used in the preparation of this reliability record
- Reliability block diagrams depicting the relationships between the reliability of the truck and its major systems and subsystems/assemblies
- An explanation of the methods used to compute the reliability values

3. DESCRIPTION OF THE TRUCK

The 6000-pound gasoline-engine-driven fork-lift truck to which this reliability record applies is a nontactical vehicle designed for handling and warehousing of materials. Its several models differ in the number of engine cylinders, the number and type of tires, the lift height, and the type of transmission. This record applies to a six-cylinder, pneumatic-tired (four 7.50 × 15 drive-wheel and two 7.50 × 10 steering-wheel tires) vehicle, with an hydraulic transmission and power steering.

The truck is powered by an internal combustion, piston-driven engine equipped to eliminate radio interference. Materials handling is accomplished by a two-pronged fork on an upright boom lift powered for lifting and tilting by an engine-mounted hydraulic pump. (The hydraulic pump also serves the truck's power steering.) The boom can be tilted forward or backward as required by the nature of the load or operation. The speed of the truck is limited by an engine governor. An overhead guard is provided to protect the operator from falling objects.

4. DESCRIPTION OF SYSTEM FUNCTIONS

The truck is composed of 15 systems that perform various functions during the mission. The systems and brief descriptions of their functions are listed in Table 1.

Table 1. **FUNCTIONAL DESCRIPTIONS OF THE TRUCK'S SYSTEMS**

Name	Functional Description
Engine System	Provides motive power for propelling the fork lift truck and for driving accessory subsystems, such as the generator assembly, water pump, and hydraulic pump
Fuel System	Delivers fuel and air mixture to the engine proportional to the vehicle's power demand
Exhaust System	Transports the products of combustion away from the engine
Cooling System	Maintains a constant and uniform engine temperature
Electrical System	Generates, regulates, and delivers electrical power for engine ignition and operation of electrical subsystems
Transmission System	Transmits engine power and regulates the power torque/speed characteristic in response to vehicle demand and operator set point
Propeller System	Transmits motive power from the transmission to the differential
Front Axle System	Transmits motive power from the propeller shaft to the front wheels
Rear Axle System	Transmits steering force to the rear wheels
Brakes System	Reduces vehicle speed by converting vehicle kinetic energy to heat energy and holds vehicle immobile when stopped
Wheels System	Supports vehicle weight and provides for vehicle rolling motion and braking action
Steering System	Controls the direction of vehicle motion in response to operator set point
Frame System	Provides primary vehicle structural support for systems and operator
Body System	Provides enclosure for vehicle systems and operator
Hydraulic Lift System	Generates, regulates, and delivers hydraulic power for lifting and tilting the load

5. MISSION PROFILE

Use of the truck generally involves: starting the engine, allowing the engine to warm up by idling, performing several operating cycles, and then stopping the engine. This procedure is repeated numerous times during an eight-hour shift. An operating cycle consists of (a) a drive function, in which the truck moves toward and maneuvers in on a load; (b) a tilting/lifting function, in which the truck picks up the load (transmission in neutral position and the handbrake engaged); (c) a transport function, in which the truck transports the load to another position; and (d) a deposit function in which the truck deposits the load (again with the transmission in neutral position and the handbrake engaged).

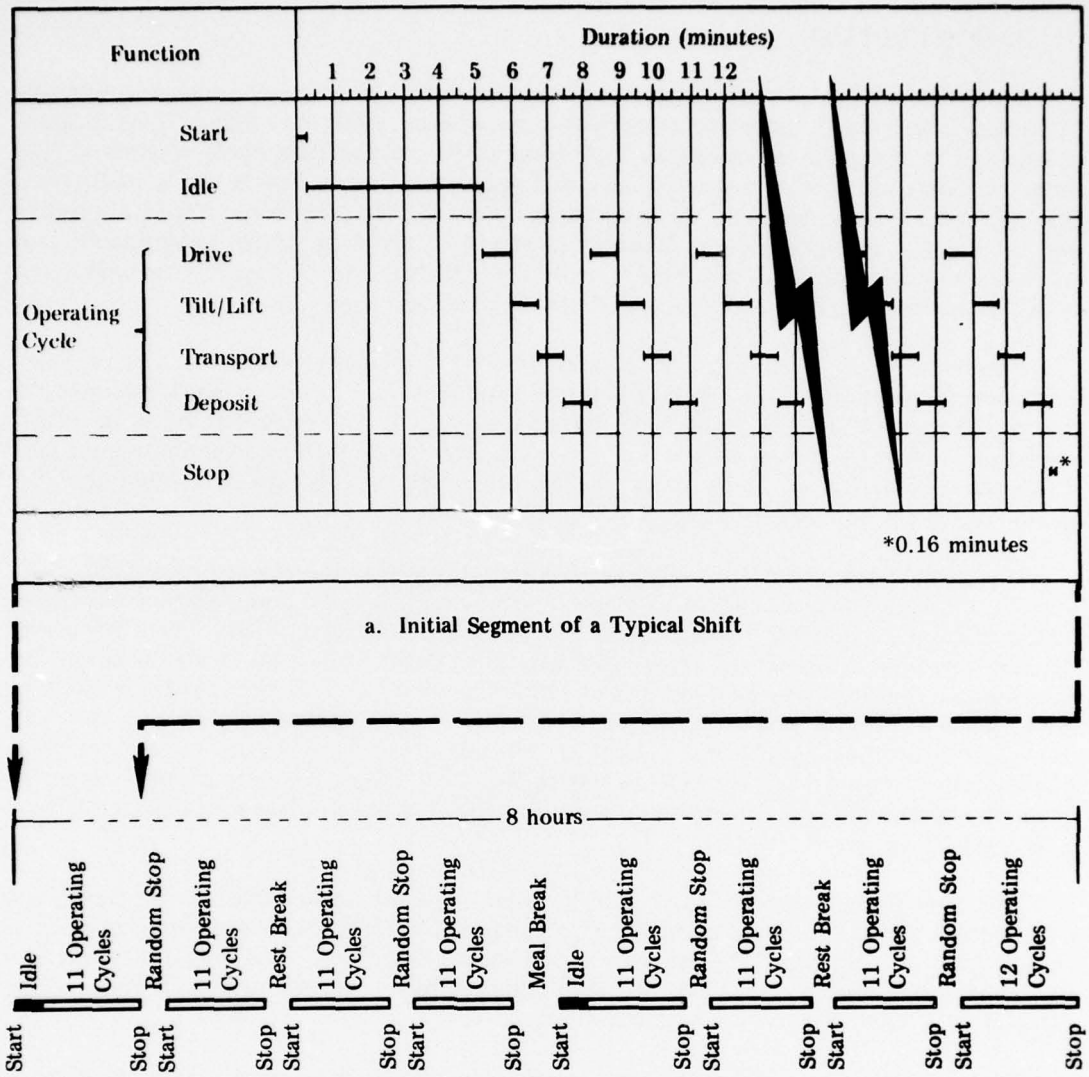
Observation of operations at several Depot warehouses disclosed that a single warehousing operation (i.e., transferring one load from one point to another) does not typify the mission of the truck. The mission is more aptly described by a full day's operation, involving numerous starts and stops and the transporting of numerous loads of different weights over different distances. Therefore, the mission profile selected describes the operation of the truck throughout an eight-hour shift.

The initial segment of a typical shift is as follows: (a) the operator performs daily preventive-maintenance tasks, such as checking oil level, coolant level, battery condition, belt condition, and lights; (b) he starts the truck and allows it to idle until the engine reaches operating temperature, (c) he proceeds through several cycles of driving to, lifting, transporting, and depositing a load, (d) he stops the engine and "parks" the truck. Such an initial segment is illustrated in Figure 1a. In addition to the final stop at the end of the shift, the vehicle is stopped for a morning break, a meal break, an afternoon break, and an average of four other times for various reasons during the shift. Engine warm-up occurs only at the beginning of the shift and after the meal break. The typical complete shift described above is illustrated in Figure 1b.

The time values shown in Figure 1 were derived from field observations and examination of vehicle-use data. In Table 2, the durations and frequencies of occurrence of the various functions are listed and converted to percentages of total operating time. The total operating time of 4.66 hours for the 8-hour mission was rounded to 5 hours in the subsequent reliability-assessment computations.

The environment in which the truck works depends on the nature of the operation it supports. In the warehousing environment typical to the Continental United States (CONUS) — for which the vehicle is designed and in which our data were gathered — the vehicle generally drives and transports across relatively flat and smooth surfaces in a moderate temperature and humidity range.

The truck is designed to facilitate ready adjustment, servicing, or replacement of fan belt, ignition assemblies and parts, carburetor and components, fuel pump and components, oil filter and components, clutch, starter, generator, generator regulator, battery, wearing parts of the steering assembly, tires, wheels, lights, and horn. In a typical CONUS Army Depot, all such work is performed by the motor pool's maintenance shop (i.e., depot level of maintenance). Any maintenance at the user location is performed by a roving mechanic from this shop. Operators do not perform any maintenance.



Total Operating Time	5 hours
Total Nonoperating Time	3 hours
Two 0.25-hour rest breaks	
One 1.00-hour meal break	
Four 0.375-hour random stops	
Total Shift (Mission) Time	8 hours

Figure 1. **MISSION PROFILE**

Table 2. **DISTRIBUTION OF TIME, BY FUNCTION, DURING ONE MISSION**

Function	Duration per Occurrence (minutes)	Frequency of Occurrence	Total Time (minutes)	Percentage of Operating Time
Start	0.25	8	2.0	0.7
Idle	5.00	2	10.0	3.6
Drive	0.75	89	66.7	23.8
Lift	0.75	89	66.7	23.8
Transport	0.75	89	66.7	23.8
Deposit	0.75	89	66.7	23.8
Stop	*0.16	8	1.3	0.5
Total Operating Time			280.1	100.00
Operating Time			**4.66 hours	
Non Operating Time			3.34 hours	
Mission Time			8.00 hours	

*Assumed value.
**Rounded to 5 hours for the reliability-assessment computations.

6. FAILURE DEFINITION

There are no QMRS, SDRs, or specific performance specifications available from which established performance limits for the 6000-pound gasoline-engine-driven fork-lift truck might be extracted. Furthermore, the TAERS/TAMMS data that were collected for reliability analysis do not record instances of marginal performance detrimental to the mission. Consequently, it was not feasible to define failure in the quantitative terms of performance criteria. As the best alternative, failure was defined as *any incident that deadlines* the vehicle during operation or that results in an unscheduled replacement or repair action.*

7. LIST OF DOCUMENTS USED

The following documents were used in preparing this reliability record:

- AMCR 702-8: Quality Assurance Reliability Record and Status Report
- TB-750-93-1: Functional Grouping Codes: Combat Tactical, and Support Vehicle and Special Purpose Equipment

*Inoperative due to damage, malfunctioning, or necessary repairs.

- MIL-STD-268C: Military Standard Test and Inspection of Trucks, Lift, Fork.
- TM 10-3930-238-35P: DG, GS, and Depot Maintenance Repair Parts and Special Tool List, Truck, Lift, Fork, Gasoline, Pneumatic-Tired Wheels, 6000 Pound Capacity Army Model MHE-193, Baker Model FJF-060, FSN 3930-738-5938.

8. RELIABILITY BLOCK DIAGRAMS

Reliability block diagrams for the 6000-pound gasoline-engine-driven fork-lift truck are presented in Figures 2 through 18. Figure 2 is an overall reliability block diagram for the truck, based on the 8-hour-shift mission. The predicted probability of the truck's completing the mission without a failure is shown to be 0.80657. Figure 3 is a function reliability diagram showing the systems that are required to operate to accomplish a given function and the relationships of the systems to one another. In all cases, the simple serial relationships are apparent. Each block is identified by the name of the system and contains (1) the Functional Grouping Code for the system, assigned in accordance with TB-250-93-1, (2) the probability, R, that the system will perform successfully for the time the vehicle operates in the specified function during the five operating hours of the eight-hour mission, (3) the percentage, t, of the total 5-hour operating time that the system operates in the specified function.

Figures 4 through 18 are reliability block diagrams for the fifteen systems of the truck. These diagrams show the reliability relationship of the major subsystems/assemblies of each system and of the major components of each subsystem/assembly. The reliability relationships of the subsystems/assemblies are represented vertically to the left of the double line; those of the components of the subsystems/assemblies are represented horizontally to the right of the double line.* In all cases, the simple serial relationships are apparent. Each block in the diagrams is identified by the name of the subsystem/assembly or component and contains (1) the Functional Group Code for the subsystem/assembly or component, (2) the probability, R, that the subsystem/assembly or component will operate successfully during the five operating hours of the 8-hour shift, and (3) the percentage, t, of the total 5-hour operating time that the subsystem/assembly or component operates. In addition, in the component blocks, a number in parentheses indicates the number of such components in the subsystem/assembly.

All the reliability values in Figures 2—18 are derived from the component failure rates tabulated, with supporting data, in the Appendix. The data were collected from maintenance and utilization records at three Depots.

9. RELIABILITY CALCULATIONS

9.1 Function Reliability

The reliability of each function is the product of the probabilities that the individual systems required for that function will perform satisfactorily *in that function* throughout the mission. The reliability of the start function, for example, is computed by the equation:

$$R_{start} = R_{06\,start} \times R_{01\,start} \times R_{03\,start}$$

*A "phantom" component, with reliability R′, is included for each subsystem/assembly to account for the failures ascribed to the subsystem/assembly as a whole.

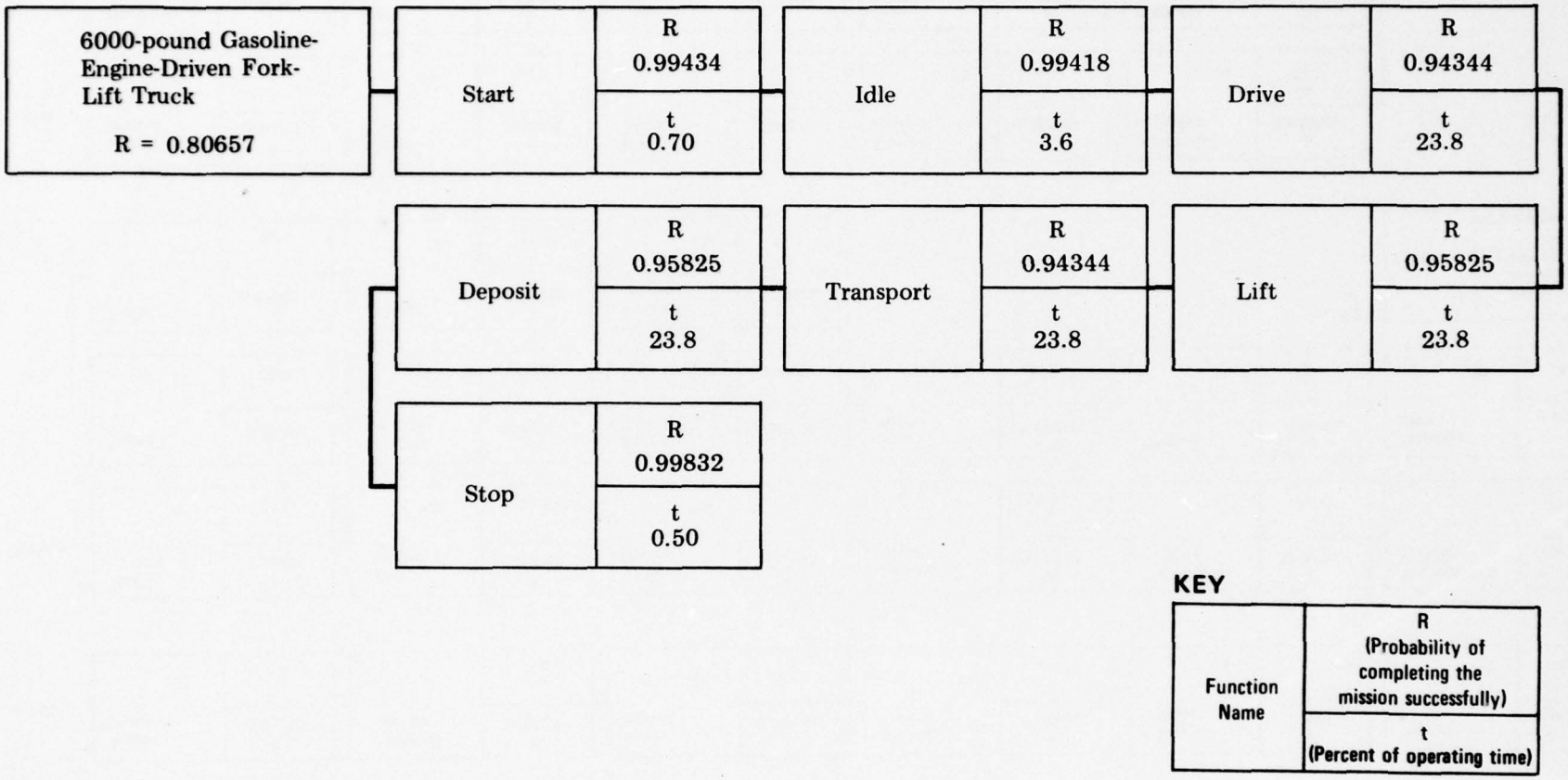


Figure 2. **TRUCK RELIABILITY BLOCK DIAGRAM**

FUNCTION

1. Start

Electrical System 06	R 0.99456 / t .70	Engine System 01	R 0.99983 / t .70	Fuel System 03	R 0.99995 / t .70

2. Idle

Engine System 01	R 0.99912 / t 3.6	Electrical System 06	R 0.99708 / t 3.6	Fuel System 03	R 0.99978 / t 3.6	Cooling System 05	R 0.99957 / t 3.6	Exhaust System 04	R 0.99985 / t 3.6	Brakes System 12	R 0.99877 / t 3.6

3. Drive

Engine System 01	R 0.99421 / t 23.8	Fuel System 03	R 0.99845 / t 23.8	Exhaust System 04	R 0.99898 / t 23.8	Cooling System 05	R 0.99715 / t 23.8	Electrical System 06	R 0.98902 / t 23.8	Transmission System 07	R 0.99752 / t 23.8
Frame 15	R 0.99971 / t 23.8	Steering System 14	R 0.99865 / t 23.8	Brakes System 12	R 0.99190 / t 23.8	Rear Axle 11	R 0.99409 / t 23.8	Front Axle 10	R 0.99964 / t 23.8	Propeller System 09	R 0.99961 / t 23.8
Body 18	R 0.99923 / t 23.8	Wheels 13	R 0.99433 / t 23.8	Hydraulic System 24	R 0.99455 / t 23.8						

KEY

Name	R (Probability of completing the mission successfully) / t (Percent of operating time)

4. Lift

Engine System 01	R 0.99421 / t 23.8	Electrical System 06	R 0.98902 / t 23.8	Fuel System 03	R 0.99845 / t 23.8	Cooling System 05	R 0.99715 / t 23.8	Exhaust System 04	R 0.99898 / t 23.8
Hydraulic System 24	R 0.99455 / t 23.8	Brake System 12	R 0.99190 / t 23.8	Body System 18	R 0.99923 / t 23.8	Frame System 15	R 0.99971 / t 23.8	Wheels 13	R 0.99433 / t 23.8

Figure 3. FUNCTION RELIABILITY BLOCK DIAGRAMS
(Sheet 1 of 2)

Function

5. Transport

Engine System	R 0.99421	Fuel System	R 0.99845	Exhaust System	R 0.99898	Cooling System	R 0.99715	Electrical System	R 0.98902
01	t 23.8	03	t 23.8	04	t 23.8	05	t 23.8	06	t 23.8

Brake System	R 0.99190	Rear Axle Axle	R 0.99409	Front Axle	R 0.99964	Propeller System	R 0.99961	Transmission System	R 0.99752
12	t 23.8	11	t 23.8	10	t 23.8	09	t 23.8	07	t 23.8

Wheels	R 0.99433	Steering System	R 0.99365	Frame	R 0.99971	Body	R 0.99923	Hydraulic System	R 0.99455
13	t 23.8	14	t 23.8	15	t 23.8	18	t 23.8	24	t 23.8

KEY

Name	R (Probability of completing the mission successfully)
	t (Percent of operating time)

6. Deposit

Engine System	R 0.99421	Fuel System	R 0.99845	Exhaust System	R 0.99898	Cooling System	R 0.99715	Electrical System	R 0.98902
01	t 23.8	03	t 23.8	04	t 23.8	05	t 23.8	06	t 23.8

Hydraulic System	R 0.99455	Body	R 0.99923	Frame	R 0.99971	Wheels	R 0.99433	Brake System	R 0.99190
24	t 23.8	18	t 23.8	15	t 23.8	13	t 23.8	12	t 23.8

7. Stop

Electrical System	R 0.99832
06	t .50

Figure 3. (Sheet 2 of 2)

The method of computing the reliability of the fuel system in the start function (the third term in the above equation) is shown below to exemplify the method used for computing all such system reliabilities.

$$R_{03\,start} = e^{-\lambda_{03} T_{start}}$$

where

λ_{03} = Failure rate of the fuel system (failures per hour)

$= \lambda_{0301} + \lambda_{0302} + \lambda_{0304} + \lambda_{0306} + \lambda_{0308} + \lambda_{0312}$

where, for example

$\lambda_{0301} = \lambda'_{0301} + \lambda_{03011} + \lambda_{03012} + \lambda_{03013} + \lambda_{03015} + \lambda_{03016}$*

therefore

$\lambda_{03} = 130.28 \times 10^{-5}$

and T_{start} = (t_{start}) (Total operating time in hours)

= (0.007) (5)

= 0.035 hours

Therefore

$R_{03\,start} = e^{-(130.28 \times 10^{-5})(0.035)}$

= 0.99995

With the other two terms computed in like manner, the reliability equation for the Start function is quantified as follows:

$$R_{start} = 0.99456 \times 0.99983 \times 0.99995$$

$$= 0.99434$$

9.2 Predicted Mission Reliability

The predicted probability of the truck's successfully completing the mission is the product of the probabilities that the individual functions will perform satisfactorily throughout the mission. This is expressed by the equation:

$$R_{mission} = R_{start} \times R_{idle} \times R_{drive} \times R_{lift} \times R_{transport} \times R_{deposit} \times R_{stop}$$

With the seven probabilities computed in the same manner as described in the previous section for R_{start}, the reliability equation for the mission is quantified as follows:

$$R_{mission} = 0.99434 \times 0.99418 \times 0.94344 \times 0.95825 \times 0.94344 \times 0.95825 \times 0.99832$$

$$= 0.80657$$

*Component failure rates (e.g., λ_{03011}) were obtained from the tabulation presented in the Appendix. The rate λ'_{xxxx} represents the "phantom" component that accounts for failures ascribed to the subsystem/assembly as a whole; these rates are included in the Appendix tabulation.

9.3 Observed Mission Reliability

The predicted mission reliability computed as outlined in Sections 9.1 and 9.2 is based on the use of component reliabilities. Component reliabilities were computed from the failure rates tabulated in the appendix. The component failure rates were derived by summing all failures and unscheduled removals or repair actions and dividing by the total component operating time. This procedure provides the best estimate of the component failure rate.

However, it was observed that during maintenance actions the mechanic often repairs or replaces more than one component — that which deadlined the truck plus those which, upon examination, he believes would preclude successful operation of the truck or one of its systems. These actions were counted against the components even though the truck failed or was deadlined only once. In the computation of truck reliability as described in Sections 9.1 and 9.2, there is an inherent assumption that a single component repair action is performed each time the truck fails or is deadlined.

Therefore, the predicted truck reliability based on component reliabilities provides a pessimistic estimate. It does not take into account the maintenance policy in effect, which requires the mechanic to inspect and repair as necessary every time a gasoline-engine-driven fork-lift truck is in the shop.

A more realistic assessment of the reliability of the 6000-pound truck can be made by computing the failure rate of the truck on the basis of its operating hours and the number of times it was down for unscheduled maintenance. The total number of times the 6000-pound fork-lift truck was down for maintenance during the time period for which the data were collected was 671. Therefore,

$$\lambda_{truck} = \frac{\text{Number of Maintenance Actions}}{\text{Total Operating Hours}}$$

$$= \frac{671}{62{,}481}$$

$$= 0.01074$$

since T = truck mission operating time = 5 hours

$$R_{truck} = e^{-\lambda_{truck} T} = e^{-(0.01074)(5)}$$

$$= e^{-0.0537}$$

$$= 0.9477$$

Therefore, the probability that the 6000-pound GED fork-lift truck will successfully complete an eight-hour (5 operating hours) mission is assessed to be 0.9477.

In a comparison of this value with that computed by the method described in Sections 9.1 and 9.2 (i.e., 0.80657), the ratio between the values of λt for each reliability value was computed as follows:

$$R_{predicted} = 0.80657 = e^{-\sum_{i=1}^{n} \lambda_i t_i T} = e^{-0.2150}$$

$$R_{truck} = 0.9477 = e^{-\lambda_{truck} T} = e^{-0.0537}$$

where

λ_i = failure rate for i^{th} component

t_i = percent of time component i operates

Therefore,

$$\frac{\sum_{i=1}^{n} \lambda_i t_i T}{\lambda_{truck} T} = \frac{0.2150}{0.0537} = 4.004$$

This ratio can be used for estimating the relationship between predictions and assessments made on 6000-pound fork-lift trucks in the future, assuming that the maintenance policy remains the same. It is emphasized that this ratio can be used for such predictions only at the truck level.

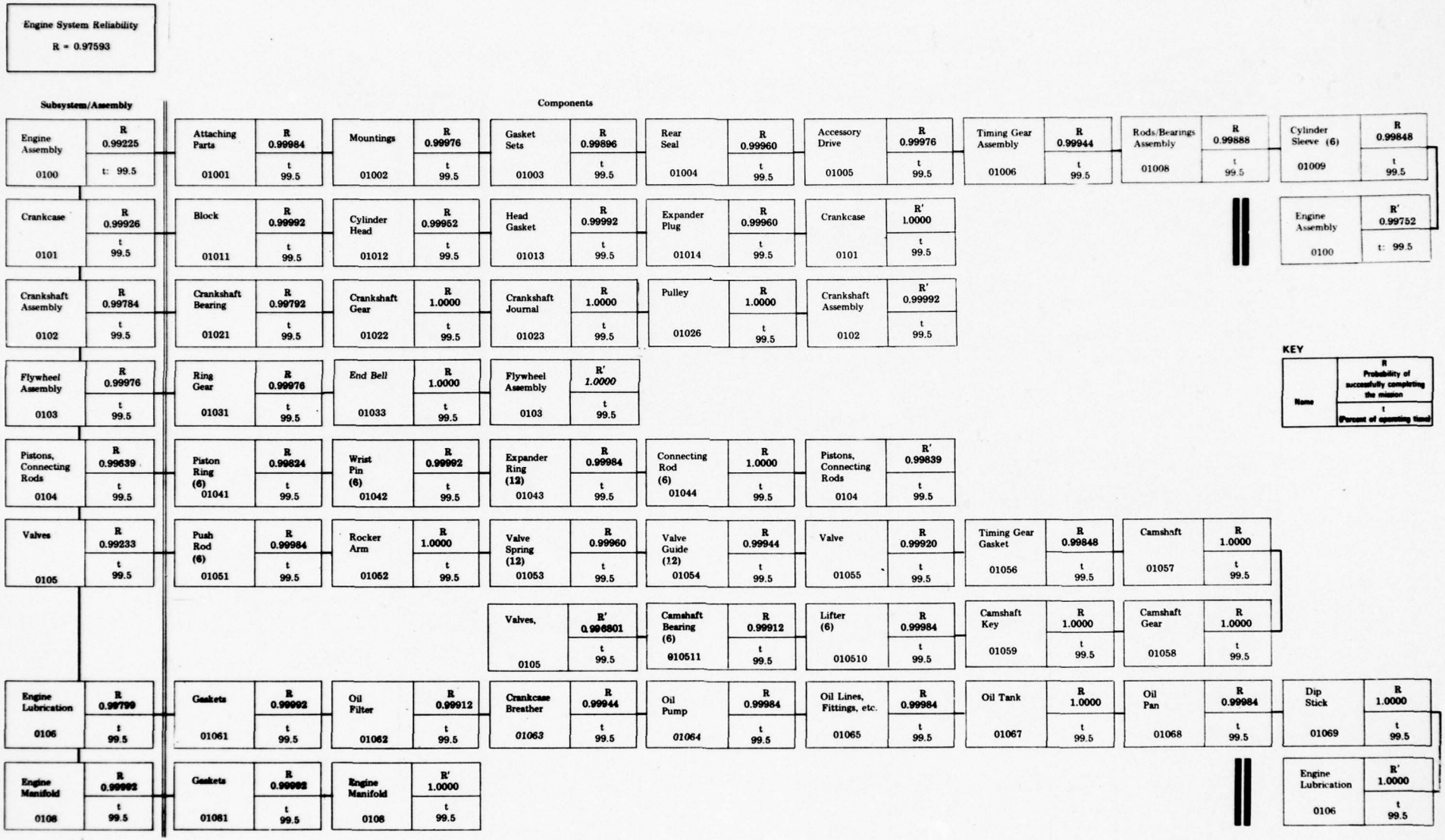


Figure 4. ENGINE SYSTEM RELIABILITY BLOCK DIAGRAM

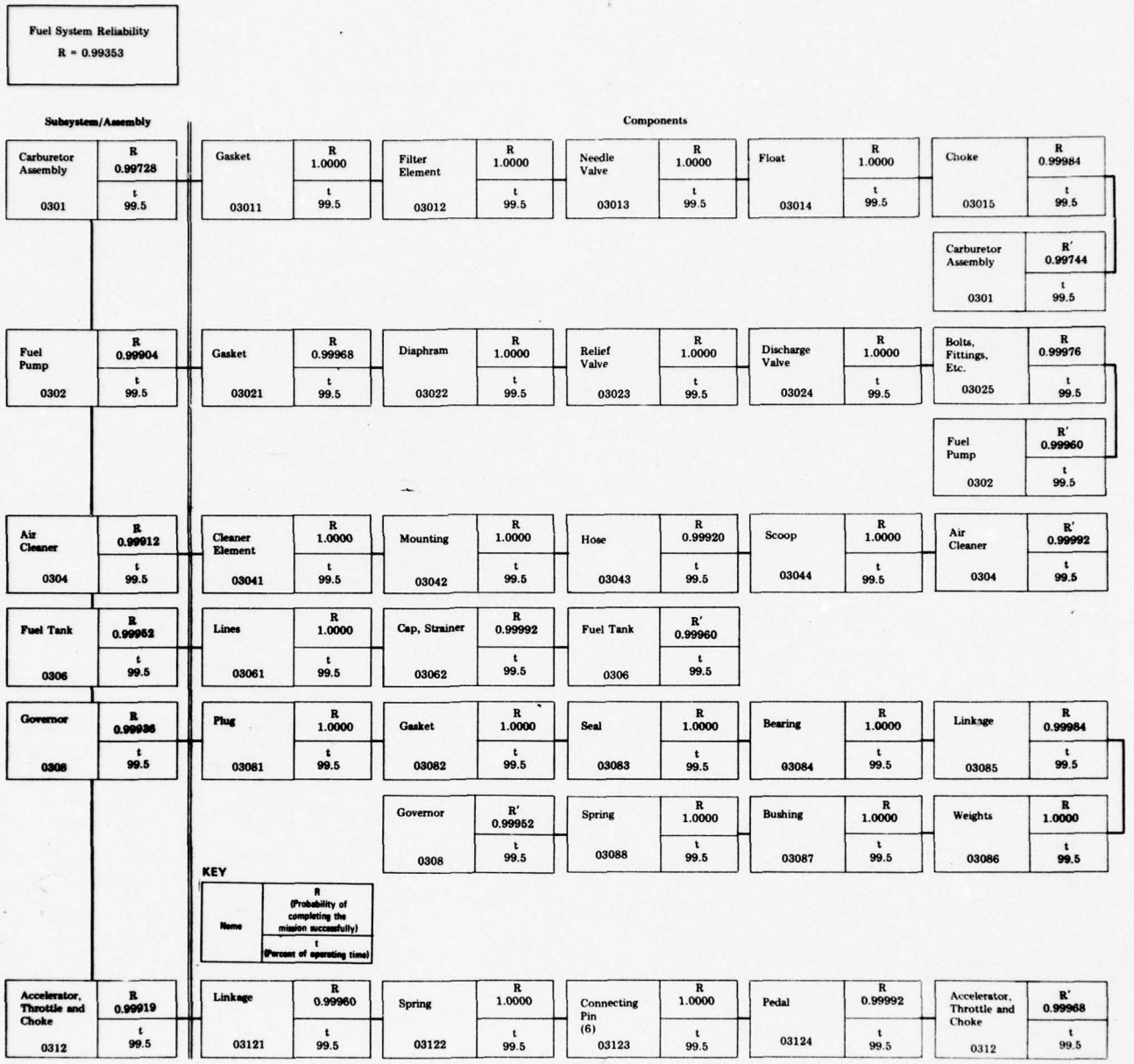


Figure 5. FUEL SYSTEM RELIABILITY BLOCK DIAGRAM

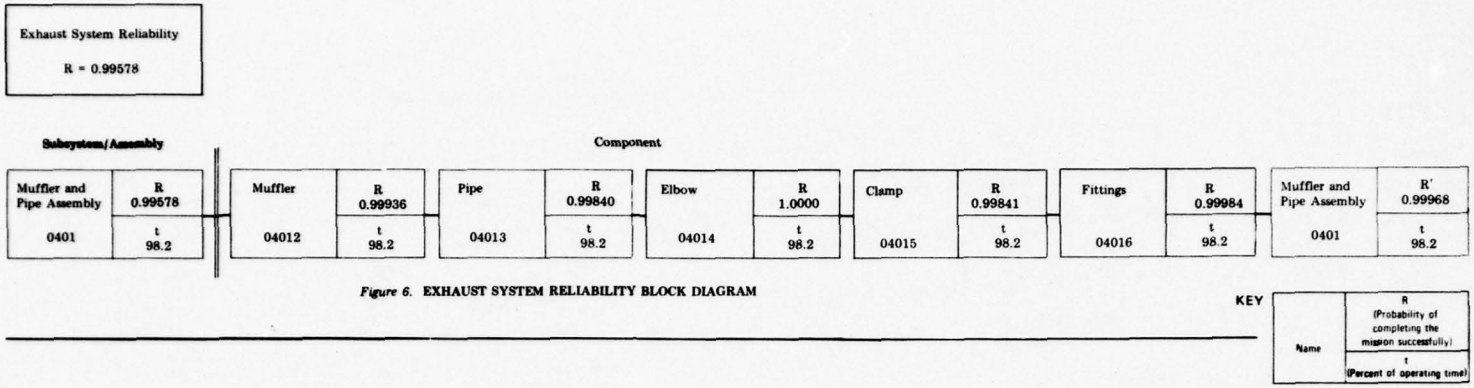


Figure 6. **EXHAUST SYSTEM RELIABILITY BLOCK DIAGRAM**

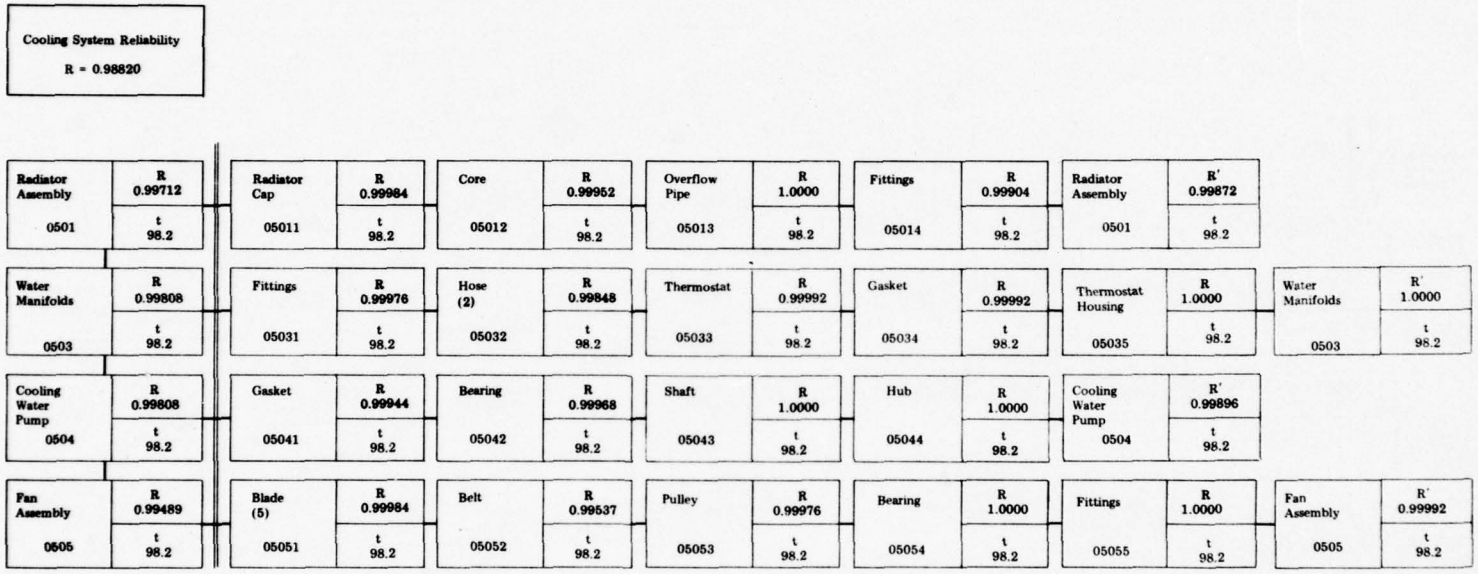


Figure 7. **COOLING SYSTEM RELIABILITY BLOCK DIAGRAM**

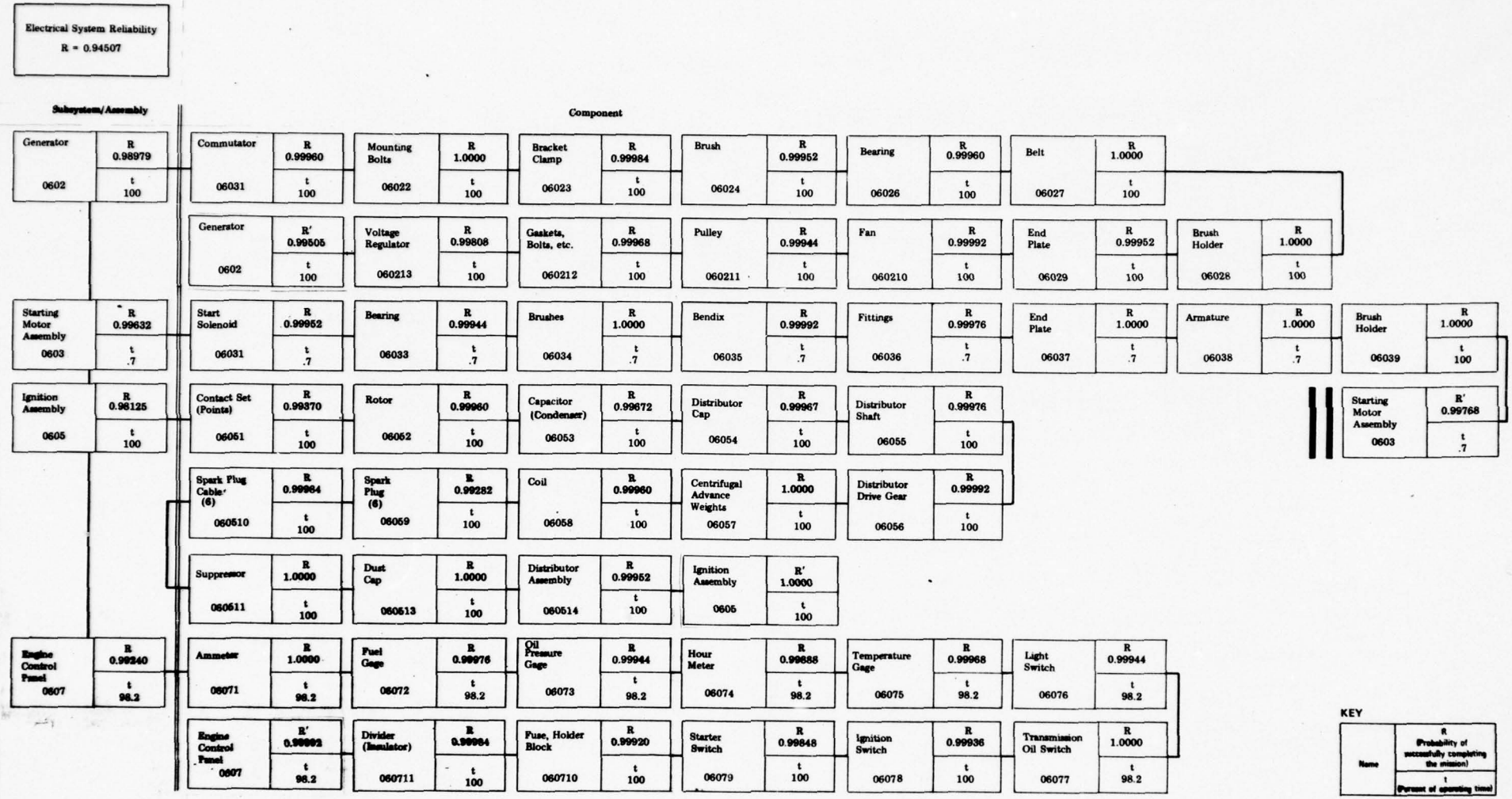


Figure 8. **ELECTRICAL SYSTEM RELIABILITY BLOCK DIAGRAM**
(Sheet 1 of 2)

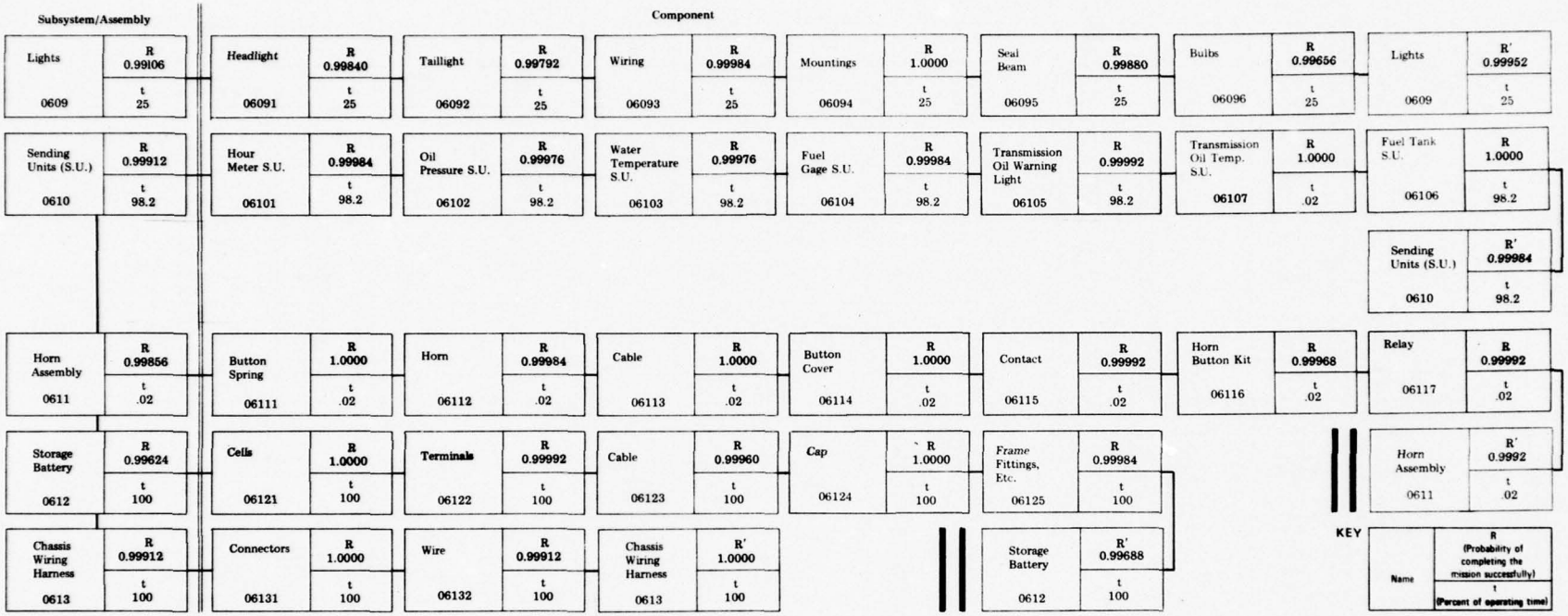


Figure 8. (Sheet 2 of 2)

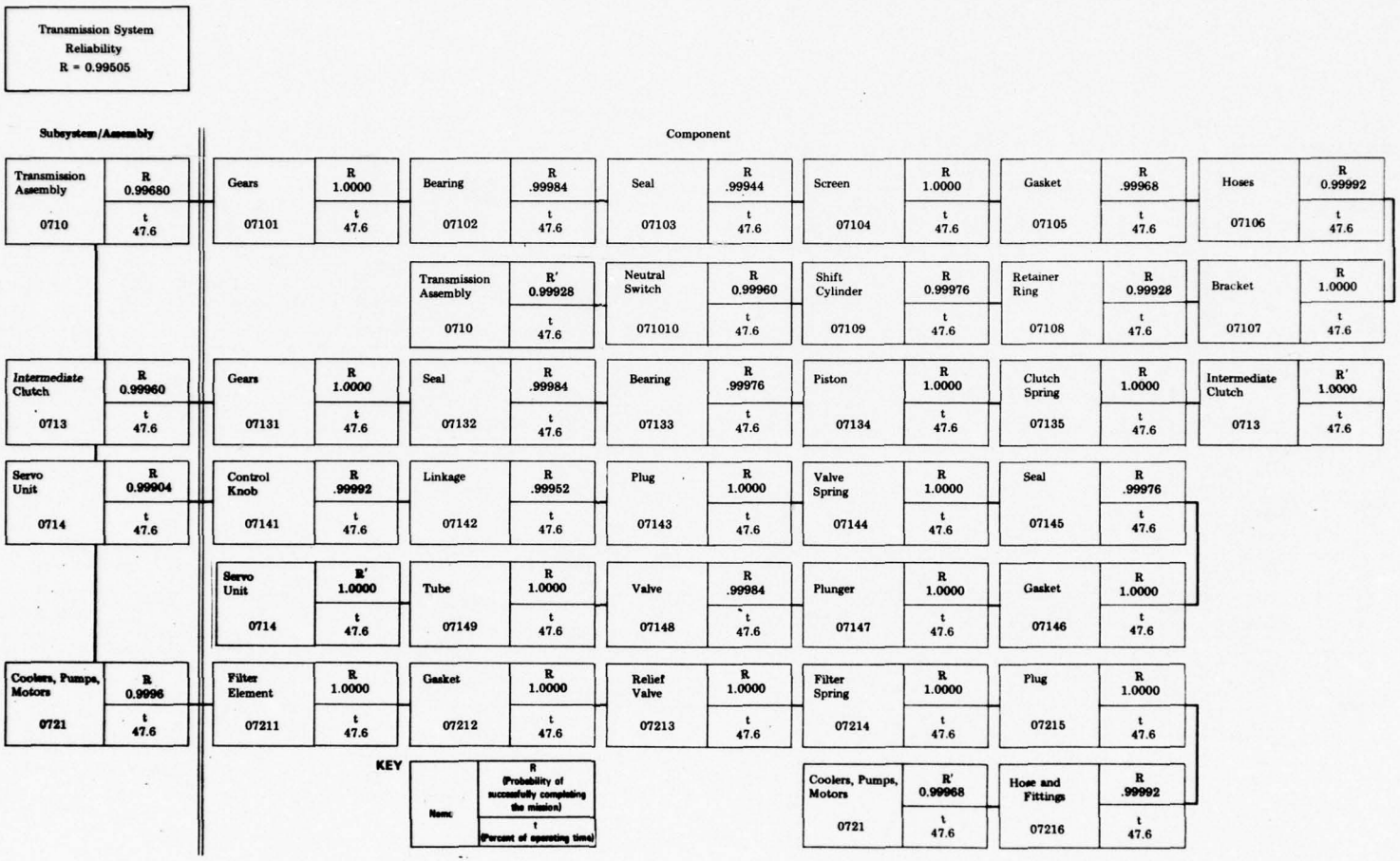


Figure 9. **TRANSMISSION SYSTEM RELIABILITY BLOCK DIAGRAM**

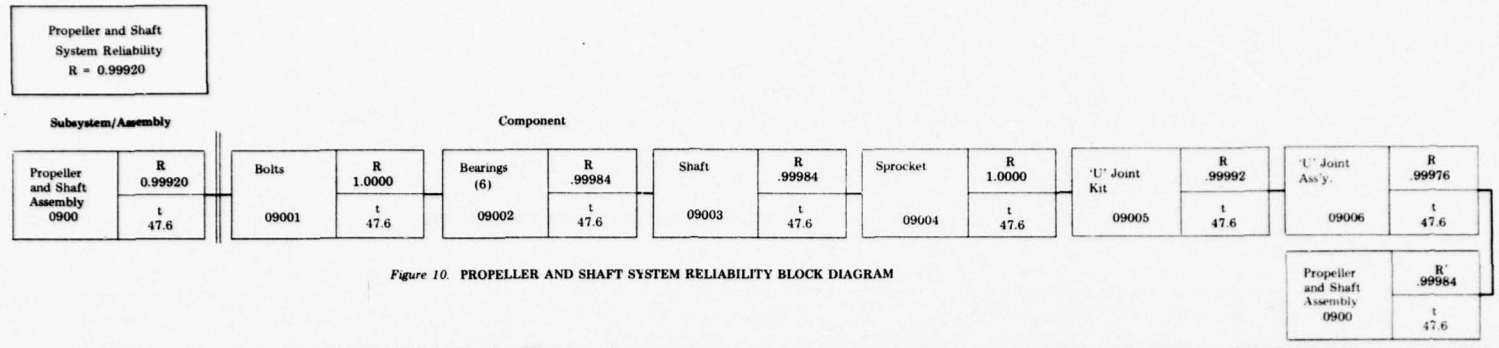


Figure 10. **PROPELLER AND SHAFT SYSTEM RELIABILITY BLOCK DIAGRAM**

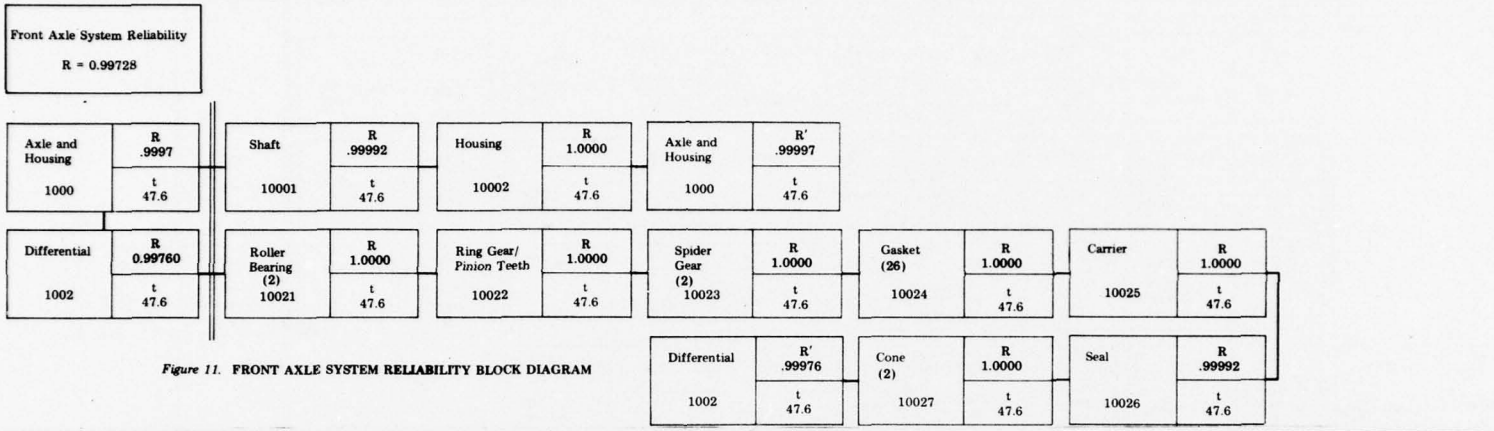


Figure 11. **FRONT AXLE SYSTEM RELIABILITY BLOCK DIAGRAM**

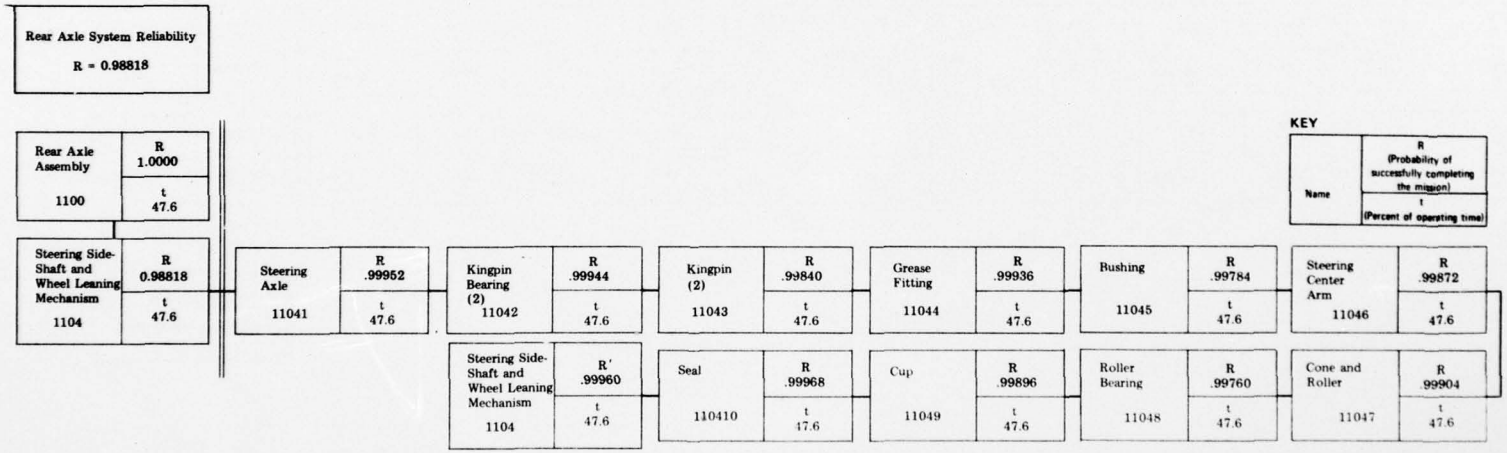


Figure 12. **REAR AXLE SYSTEM RELIABILITY BLOCK DIAGRAM**

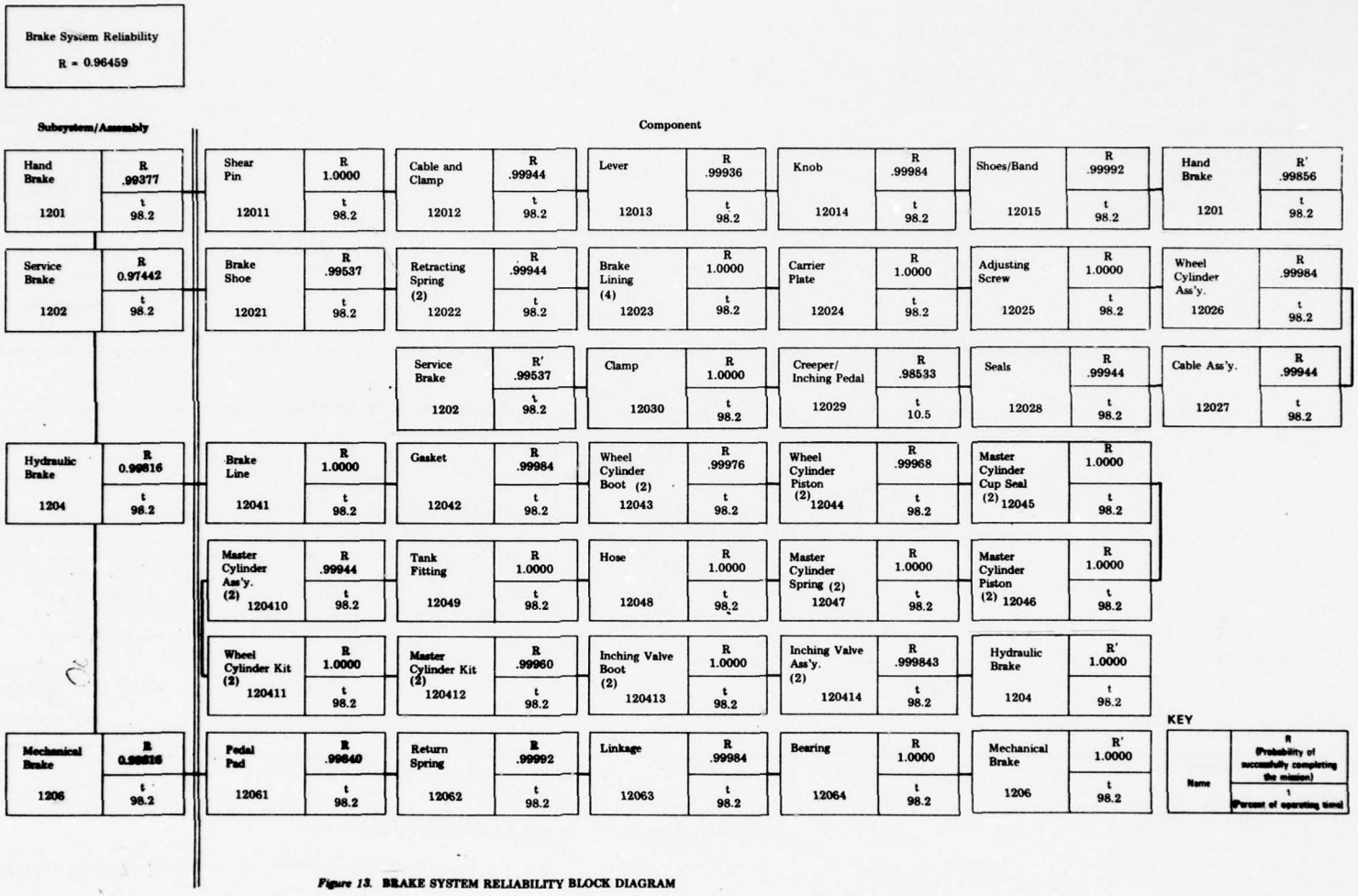


Figure 13. **BRAKE SYSTEM RELIABILITY BLOCK DIAGRAM**

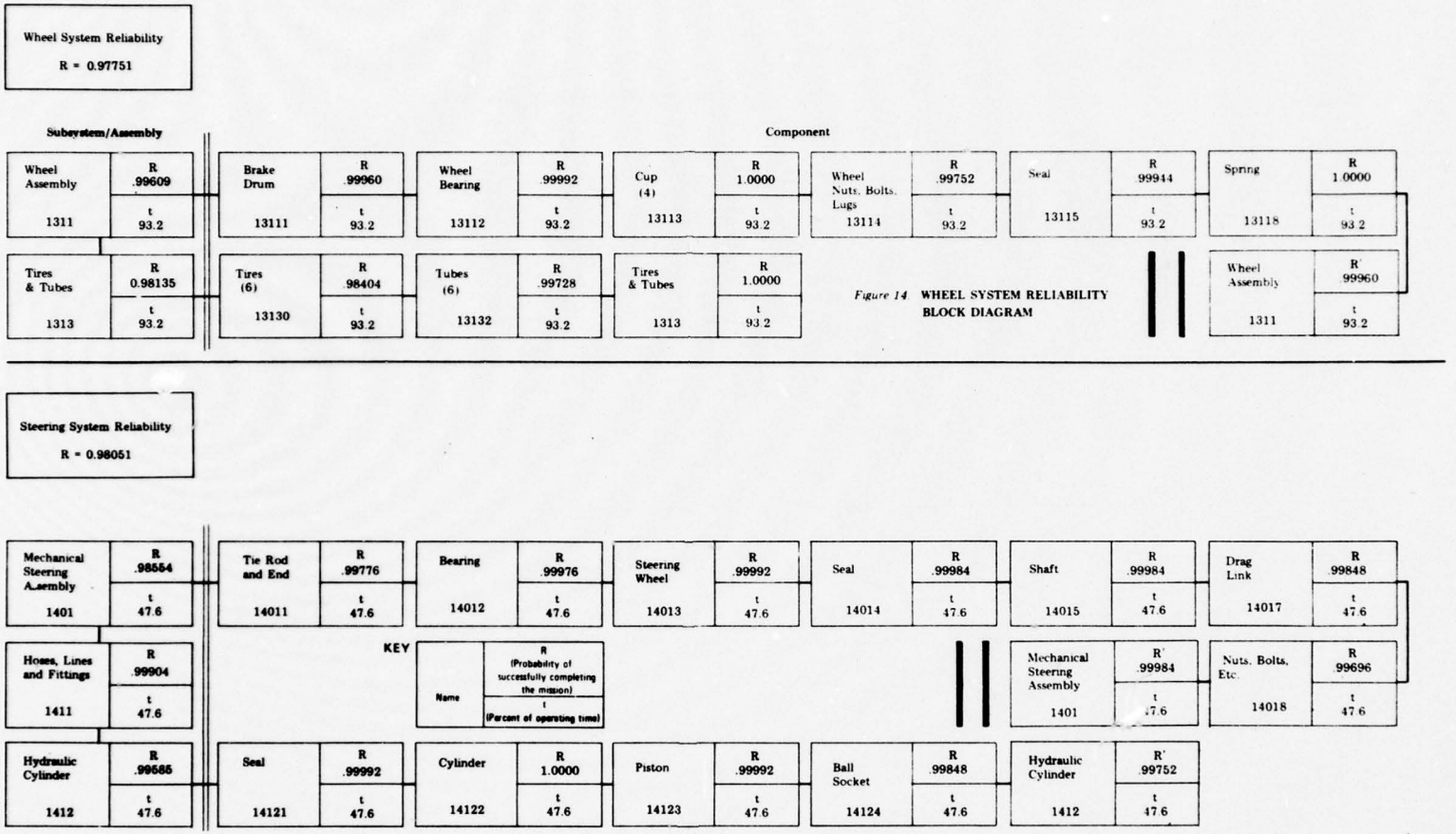


Figure 14 **WHEEL SYSTEM RELIABILITY BLOCK DIAGRAM**

Figure 15. **STEERING SYSTEM RELIABILITY BLOCK DIAGRAM**

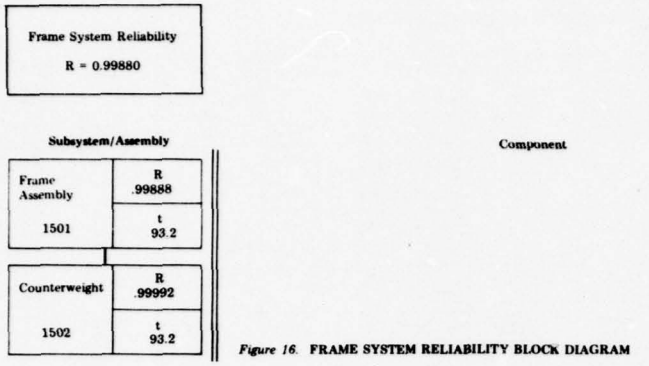


Figure 16. **FRAME SYSTEM RELIABILITY BLOCK DIAGRAM**

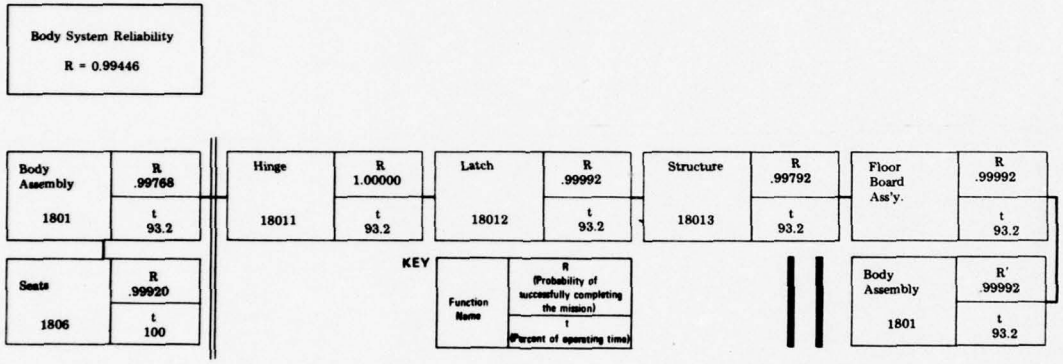


Figure 17. **BODY SYSTEM RELIABILITY BLOCK DIAGRAM**

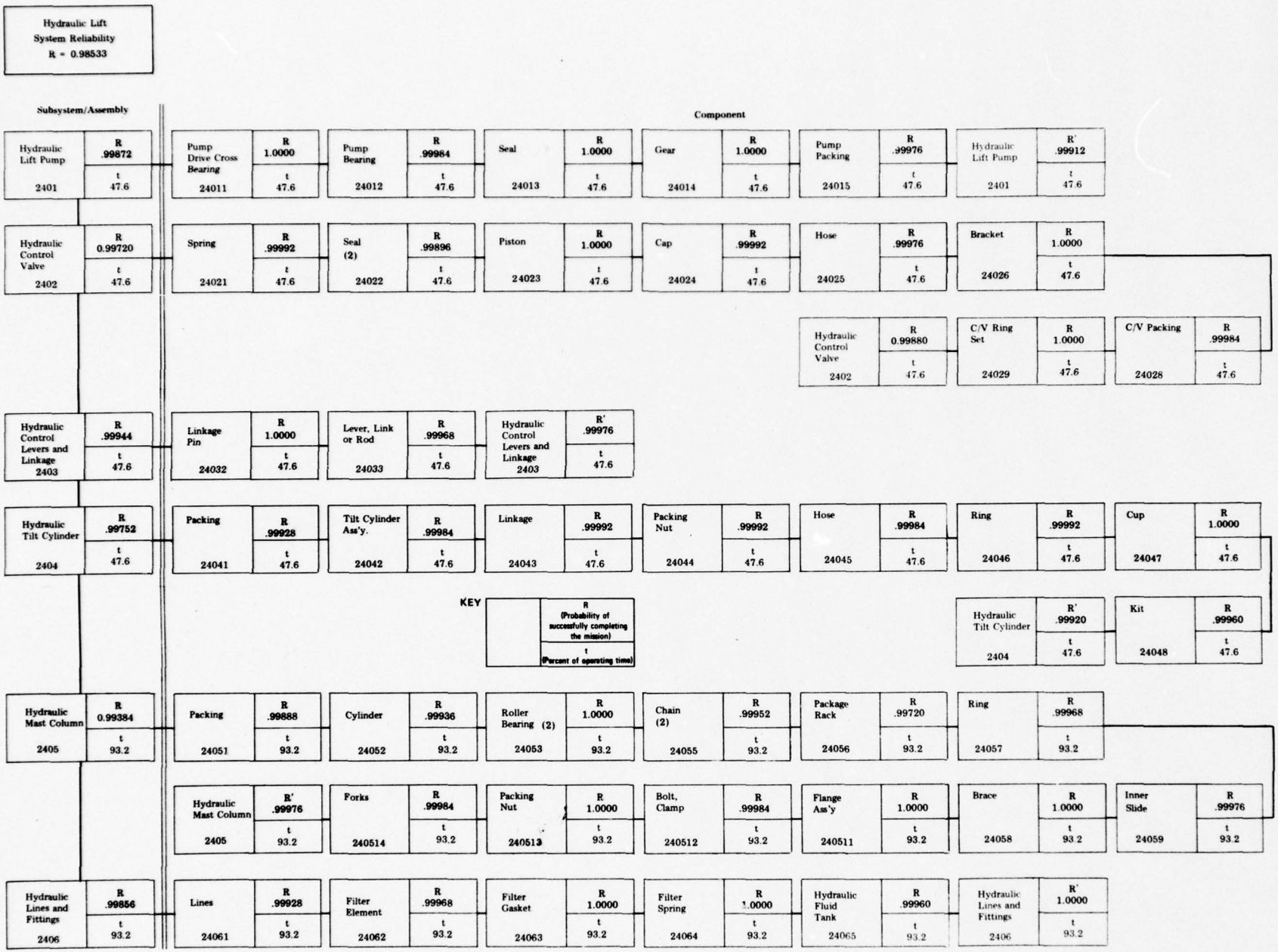


Figure 18. HYDRAULIC LIFT SYSTEM RELIABILITY BLOCK DIAGRAM

PART B

RELIABILITY STATUS REPORT

1. PURPOSE

Part B of this document presents reliability, maintainability, and availability values for the 6000-pound gasoline-engine-driven fork-lift truck and its constituent systems. The values are inserted on AMC Form 1576-R, following the summary of computational procedures in the following sections.

2. COMPUTATIONAL PROCEDURES

2.1 Reliability

The system reliability values were computed for the 5-hour operating period observed to be typical for an 8-hour shift (the mission period). The probability that the engine system, for example, will operate successfully for the duration of the mission is computed as follows:

$$R_{engine} = R_{0100} \times R_{0101} \times R_{0102} \times R_{0103} \times R_{0104} \times R_{0105} \times R_{0106} \times R_{0108}$$

$$= 0.99225 \times 0.99926 \times 0.99784 \times 0.99976 \times 0.99639 \times 0.99233 \times 0.99799 \times 0.99992$$

$$= 0.97593$$

In which, for example,

$$R_{0101} = e^{-(\lambda_{0101})\,(T_{0101})}$$

where

$$\lambda_{0101} = \lambda'_{0101} + \lambda_{01011} + \lambda_{01012} + \lambda_{01013} + \lambda_{01014} = 14.91 \times 10^{-5}*$$

T_{0101} = (t_{0101}) (Total operating time in hours) = (0.995) (5) = 4.98 hours

where

t_{0101} = percentage of operating time component operates during mission as determined from Reliability Record of Fork-Lift-Truck Family.

Therefore

$$R_{0101} = e^{-(14.91 \times 10^{-5})\,(4.98)} = 0.99926$$

---

*Component failure rates (e.g., λ_{01011}) were obtained from the tabulation presented in the Appendix. The rate λ'_{xxxx} represents the "phantom" component that accounts for failures ascribed to the subsystem/assembly as a whole; these rates are included in the Appendix tabulation.

2.2 Maintainability

The values shown in Status Report Part B for truck and system maintainability are the mean maintenance manhours per failure for the truck or system. They were computed by summing the total manhours expended to remedy the failures of the subsystem/assemblies or parts and dividing by the total number of failures. The data for these computations were taken from the Reliability Record for the Fork-Lift-Truck Family. The mean maintenance manhours per failure is considered equivalent to the usual measure of maintainability, mean time to repair, since failures are virtually all corrected by a single maintenance man.

2.3 Availability

Availability for the fork lift truck is defined as the probability that the truck is operating or is ready to operate at any point in time. The following expression is used to compute availability:

$$A_i \cong \frac{\dfrac{1}{\lambda_i t_i}}{\dfrac{1}{\lambda_i t_i} + MMMH_i}$$

where

λ_i = failure rate of i^{th} item

t_i = proportion of mission time during which item i operates

$MMMH_i$ = mean maintenance man hours for i^{th} item (equivalent to mean time to repair as explained in the previous section)

This expression is valid when the following conditions apply:

1. A continuous demand for the truck exists during the 5-hour operating period
2. Maintenance personnel are available only during the same 5-hour operating period
3. Maintenance is initiated immediately when failure occurs
4. $MMMH_i \ll \dfrac{1}{\lambda_i t_i}$

Since these conditions are essentially met in the situation under consideration, the expression provides a reasonable estimate of availability.

As an example of the computation, the availability of the Propeller System is determined as follows. From the failure rate data in the Appendix, the sum of the failure rates for the Propeller System is 33.61×10^{-5} failures per hour. Since the proportion of mission time during which each component operates (t_i) is the same for all components,

$$\Sigma \lambda_i t_i = t_i \Sigma \lambda_i$$

Therefore,

$$\Sigma \lambda_i t_i = 0.476 (33.61 \times 10^{-5}) = 15.998 \times 10^{-5}$$

For the Propeller System, the MMMH is 3.06 hours per failure. Therefore, the availability is

$$A = \frac{\frac{1}{15.998 \times 10^{-5}}}{\frac{1}{15.998 \times 10^{-5}} + 3.06}$$

$$= 0.99951$$

This procedure is applicable for all systems in the truck. When the observed overall truck availability is computed, however, the fact that an average of 4.004 failures were corrected during each maintenance event must be accounted for (see Section 9.3). At the truck level, then, where $\Sigma \lambda_i t_i = 0.043$, we obtain the observed availability

$$A = \frac{\frac{4.004}{0.043}}{\frac{4.004}{0.043} + 1.06} = 0.9887$$

Data limitations prohibit the computation of such correction factors for multiple maintenance events at the system or lower levels.

RELIABILITY STATUS REPORT - PART B
(AMCR 702-8)

REPORTS CONTROL SYMBOL
AMCQA - 113

RESPONSIBLE ACTIVITY

IDENTIFICATION	CHARACTERISTICS	REQUIREMENTS		STATUS	
END ITEM/SYSTEM BREAKDOWN	PRIMARY PERFORMANCE CHARACTERISTICS	ESSENTIAL OMR/SDR REQUIREMENT	SPECIFICATION REQUIREMENTS	STATUS BASED ON TEST RESULTS	STATUS BASED ON OPERATIONAL USE
6000-lb. GED Fork-Lift Truck	Reliability (1)				.9477
	Maintainability (2)				1.06
	Availability (3)	None	None	Test Results Not Available	.9887
Engine System	Reliability (4)				.97593
	Maintainability (2)				1.88
	Availability (3)				.99092

NOTES:

1. Probability of completing an 8-hour shift (5 operating hours) without failure. See Section 9.3.
2. Mean Maintenance Man-hours per failure.
3. Probability of operating or being ready to operate at any point in time.
4. Predicted on the basis of component reliabilities.

Operational status based upon assessment of maintenance and utilization data from a sample of 64 6,000 lb. GED fork-lift trucks which accumulated a total of 62,481 operating hours from 1 Jan. 1969 through 1 July 1970. The age range of this sample of trucks was between 1 and 16 years with the average age being 5.86 years.

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AMC FORM 9 NOV 67 1576-R

RELIABILITY STATUS REPORT--PART B
(AMCR 702-8)

RESPONSIBLE ACTIVITY

REPORTS CONTROL SYMBOL
AMCQA - 113

IDENTIFICATION	CHARACTERISTICS	REQUIREMENTS		STATUS	
END ITEM/SYSTEM BREAKDOWN	PRIMARY PERFORMANCE CHARACTERISTICS	ESSENTIAL QMR/SDR REQUIREMENT	SPECIFICATION REQUIREMENTS	STATUS BASED ON TEST RESULTS	STATUS BASED ON OPERATIONAL USE
Fuel System	Reliability (4)				.99353
	Maintainability (2)				1.02
	Availability (3)				.99867
Exhaust System	Reliability (4)				.99578
	Maintainability (2)				0.99
	Availability (3)				.99916
Cooling System	Reliability (4)				.98601
	Maintainability (2)				1.26
	Availability (3)				.99702

NOTES:

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RELIABILITY STATUS REPORT--PART B
(AMCR 702-8)

REPORTS CONTROL SYMBOL
AMCQA - 113

RESPONSIBLE ACTIVITY

IDENTIFICATION	CHARACTERISTICS	REQUIREMENTS		STATUS	
END ITEM/SYSTEM BREAKDOWN	PRIMARY PERFORMANCE CHARACTERISTICS	ESSENTIAL QMR/SDR REQUIREMENT	SPECIFICATION REQUIREMENTS	STATUS BASED ON TEST RESULTS	STATUS BASED ON OPERATIONAL USE
Electrical System	Reliability (4)				.94507
	Maintainability (2)				0.65
	Availability (3)				.99270
Transmission System	Reliability (4)				.99505
	Maintainability (2)				2.02
	Availability (3)				.99802
Propeller System	Reliability (4)				.99920
	Maintainability (2)				3.06
	Availability (3)				.99951

NOTES:

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AMC FORM 9 NOV 67 1576-R

RELIABILITY STATUS REPORT--PART B
(AMCR 702-8)

REPORTS CONTROL SYMBOL
AMCQA - 113

RESPONSIBLE ACTIVITY

IDENTIFICATION	CHARACTERISTICS	REQUIREMENTS		STATUS	
END ITEM/SYSTEM BREAKDOWN	PRIMARY PERFORMANCE CHARACTERISTICS	ESSENTIAL QMR/SDR REQUIREMENT	SPECIFICATION REQUIREMENTS	STATUS BASED ON TEST RESULTS	STATUS BASED ON OPERATIONAL USE
Front Axle System	Reliability (4)				.99728
	Maintainability (2)				2.80
	Availability (3)				.98499
Rear Axle System	Reliability (4)				.98818
	Maintainability (2)				1.13
	Availability (3)				.99755
Brake System	Reliability (4)				.96459
	Maintainability (2)				1.11
	Availability (3)				.99206

NOTES:

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AMC FORM 9 NOV 67 1576-R

RELIABILITY STATUS REPORT--PART B
(AMCR 702-8)

REPORTS CONTROL SYMBOL
AMCQA - 113

RESPONSIBLE ACTIVITY

IDENTIFICATION	CHARACTERISTICS	REQUIREMENTS		STATUS	
END ITEM/SYSTEM BREAKDOWN	PRIMARY PERFORMANCE CHARACTERISTICS	ESSENTIAL QMR/SDR REQUIREMENT	SPECIFICATION REQUIREMENTS	STATUS BASED ON TEST RESULTS	STATUS BASED ON OPERATIONAL USE
Wheels System	Reliability (4)				.97751
	Maintainability (2)				1.04
	Availability (3)				.99529
Steering System	Reliability (4)				.98051
	Maintainability (2)				1.13
	Availability (3)				.99556
Frame System	Reliability (4)				.99880
	Maintainability (2)				1.67
	Availability (3)				.99959

NOTES:

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AMC FORM 9 NOV 67 1576-R

RELIABILITY STATUS REPORT--PART B
(AMCR 702-8)

REPORTS CONTROL SYMBOL
AMCQA - 113

RESPONSIBLE ACTIVITY

IDENTIFICATION	CHARACTERISTICS	REQUIREMENTS		STATUS	
END ITEM/SYSTEM BREAKDOWN	PRIMARY PERFORMANCE CHARACTERISTICS	ESSENTIAL QMR/SDR REQUIREMENT	SPECIFICATION REQUIREMENTS	STATUS BASED ON TEST RESULTS	STATUS BASED ON OPERATIONAL USE
Body System	Reliability (4)				.99446
	Maintainability (2)				1.57
	Availability				.99826
Hydraulic System	Reliability (4)				.98533
	Maintainability (2)				1.24
	Availability				.98975

NOTES:

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DATE

AMC FORM 9 NOV 67 1576-R

APPENDIX

FAILURE-RATE DATA

NOTE

The values marked by an asterisk are for the "phantom" component that represents failures ascribed to the subsystem/assembly as a whole. This rate must be added to the other appropriate component failure rates to determine the failure rate of the subsystem/assembly.

The failure rates shown represent the rate of failure for that part or group of similar parts in the subsystem/assembly. For example, the failure rate for the group of six spark plugs (06059) is represented by the value in the table. The failure rate for a single spark plug would be this number divided by six.

6000 POUND FORK-LIFT TRUCK FAILURE RATE DATA

Functional Group Code	Part Name	Operating Hours	Number of Failures	Failures/ 10^5 Hours
0100	Engine Assembly	62,169	31*	49.86*
01001	Attaching Parts	62,169	2	3.22
01002	Mountings	62,169	3	4.82
01003	Gasket Sets	62,169	13	20.91
01004	Rear Seal	62,169	5	8.04
01005	Accessory Drive	62,169	3	4.82
01006	Timing Gear Assembly	62,169	7	11.26
01008	Rods/Bearing Assembly	62,169	14	22.52
01009	Cylinder Sleeve (6)	62,169	19	30.56
0101	Crankcase	62,169	0 *	0*
01011	Block	62,169	1	1.61
01012	Cylinder Head	62,169	6	3.65
01013	Head Gasket	62,169	1	1.61
01014	Expander Plug	62,169	5	8.04
0102	Crankshaft Assembly	62,169	1*	1.61*
01021	Crankshaft Bearing	62,169	26	41.82
01022	Crankshaft Gear	62,169	0	0
01023	Crankshaft Journal	62,169	0	0
01026	Pulley	62,169	0	0
0103	Flywheel Assembly	62,169	0*	0*
01031	Ring Gear	62,169	3	4.82
01033	End Bell	62,169	0	0
0104	Pistons (6)	62,169	20*	32.17*
01041	Piston Rings (6)	62,169	22	35.39
01042	Wrist Pin (6)	62,169	1	1.61
01043	Expander Ring (12)	62,169	2	3.22
01044	Connecting Rod (6)	62,169	0	0

*See important note on Appendix cover sheet

6000 POUND FORK-LIFT TRUCK FAILURE RATE DATA				
Functional Group Code	Part Name	Operating Hours	Number of Failures	Failures/ 10^5 Hours
0105	Valves	62,169	40*	64.34*
01051	Push Rods (6)	62,169	2	3.22
01052	Rocker Arm	62,169	0	0
01053	Valve Spring (12)	62,169	5	8.05
01054	Valve Guide (12)	62,169	7	11.26
01055	Valve Cover	62,169	10	16.08
01056	Gasket	62,169	19	30.56
01057	Camshaft	62,169	0	0
01058	Camshaft Gear	62,169	0	0
01059	Camshaft Key	62,169	0	0
010510	Lifter (6)	62,169	2	3.22
010511	Camshaft Bearing (6)	62,169	11	17.69
0106	Engine Lubrication	62,169	0*	0*
01061	Gaskets	62,169	1	1.61
01062	Oil Filter	62,169	11	17.69
01063	Crankcase Breather	62,169	7	11.26
01064	Oil Pump	62,169	2	3.22
01065	Oil Lines, Fittings, etc.	62,169	2	3.22
01067	Oil Tank	62,169	0	0
01068	Oil Pan	62,169	2	3.22
01069	Dip Stick	62,169	0	0
0108	Engine Manifold	62,169	0*	0*
01081	Gasket	62,169	1	1.61
0301	Carburetor Assembly	62,169	32*	51.47*
03011	Gasket	62,169	0	0
03012	Filter Element	62,169	0	0
03013	Needle Valve	62,169	0	0
03015	Float	62,169	0	0
03016	Choke	62,169	2	3.22

*See important note on Appendix cover sheet

6000 POUND FORK-LIFT TRUCK FAILURE RATE DATA

Functional Group Code	Part Name	Operating Hours	Number of Failures	Failures/ 10^5 Hours
0302	Fuel Pump	62,169	5*	8.04*
03021	Gasket	62,169	4	6.43
03022	Diaphram	62,169	0	0
03023	Relief Valve	62,169	0	0
03024	Discharge Valve	62,169	0	0
03025	Bolts, Fittings, etc.	62,169	3	4.83
0304	Air Cleaner	62,169	1*	1.61*
03041	Cleaner Element	62,169	0	0
03042	Mounting	62,169	0	0
03043	Hose	62,169	10	16.08
03044	Scoop	62,169	0	0
0306	Fuel Tank	62,167	5*	8.04*
03061	Lines	62,167	0	0
03062	Cap, Strainer	62,167	1	1.61
0308	Governor	62,167	6*	9.65*
03081	Plug	62,167	0	0
03082	Gasket	62,167	0	0
03083	Seal	62,167	0	0
03084	Bearing	62,167	0	0
03085	Linkage	62,167	2	3.22
03086	Weights	62,167	0	0
03087	Bushing	62,167	0	0
03088	Spring	62,167	0	0
0312	Accelerator Throttle and Choke	62,167	4*	6.43*
03121	Linkage	62,167	5	8.04
03122	Spring	62,167	0	0
03123	Connecting Pin (6)	62,167	0	0
03124	Pedal	62,167	1	1.61

*See important note on Appendix cover sheet

6000 POUND FORK-LIFT TRUCK FAILURE RATE DATA				
Functional Group Code	Part Name	Operating Hours	Number of Failures	Failures/ 10^5 Hours
0401	Muffler and Pipe Assembly	61,731	4*	6.48*
04012	Muffler	61,731	8	12.96
04013	Pipe	61,731	20	32.40
04014	Elbow	61,731	0	0
04015	Clamp	61,731	19	30.78
04016	Fittings	61,731	2	3.24
0501	Radiator Assembly	61,731	16*	25.92*
05011	Radiator Cap	61,731	2	3.24
05012	Core	61,731	6	9.72
05013	Overflow Pipe	61,731	0	0
05014	Fittings	61,731	12	19.44
0503	Water Manifold	61,731	0*	0*
05031	Fittings	61,731	3	4.86
05032	Hose (2)	61,731	19	30.78
05033	Thermostat	61,731	1	1.62
05034	Gasket	61,731	1	1.62
05035	Thermostat Housing	61,731	0	0
0504	Water Pump	61,731	13*	21.06*
05041	Gasket	61,731	7	11.34
05042	Bearing	61,731	4	6.48
05043	Shaft	61,731	0	0
05044	Hub	61,731	0	0
0505	Fan Assembly	61,731	1*	1.62*
05051	Blade (5)	61,731	2	3.24
05052	Belt	61,731	58	93.96
05053	Pulley	61,731	3	4.86
05054	Bearing	61,731	0	0
05055	Fittings	61,731	0	0

*See important note on Appendix cover sheet

6000 POUND FORK-LIFT TRUCK FAILURE RATE DATA

Functional Group Code	Part Name	Operating Hours	Number of Failures	Failures/ 10^5 Hours
0602	Generator	62,481	62*	99.23*
06021	Commutator	62,481	5	8.00
06022	Mounting Bolts	62,481	0	0
06023	Bracket, Clamp	62,481	2	3.20
06024	Brush	62,481	6	9.60
06026	Bearing	62,481	5	8.00
06027	Belt	62,481	0	0
06028	Brush Holder	62,481	0	0
06029	End Plate	62,481	6	9.60
060210	Fan	62,481	1	1.60
060211	Pulley	62,481	7	11.20
060212	Gaskets, Bolts, Etc.	62,481	4	6.40
060213	Voltage Regulator	62,481	24	38.41
0603	Starter Assembly	437.37	29*	6630.54*
06031	Start Solenoid	437.37	6	1371.84
06033	Bearings	437.37	7	1600.47
06034	Brushes	437.37	0	0
06035	Bendix	437.37	1	228.64
06036	Fittings	437.37	3	685.92
06037	End Plate	437.37	0	0
06038	Armature	437.37	0	0
06039	Brush Holder	437.37	0	0
0605	Ignition Assembly	62,481	0*	0*
06051	Contact Set	62,481	79	126.44
06052	Rotor	62,481	5	8.00
06053	Capacitor (condenser)	62,481	41	65.62
06054	Distributor Cap	62,481	3	4.80
06055	Timing Distributor Shaft	62,481	3	4.80
06056	Distributor Drive Gear	62,481	1	1.60
06057	Centrifugal Advance Weights	62,481	0	0
06058	Coil	62,481	5	8.00
06059	Spark Plug (6)	62,481	90	144.04
060510	Spark Plug Cable (6)	62,481	2	3.20

0605 CONTINUED ON NEXT PAGE

*See important note on Appendix cover sheet

6000 POUND FORK-LIFT TRUCK FAILURE RATE DATA

Functional Group Code	Part Name	Operating Hours	Number of Failures	Failures/ 10^5 Hours
060511	Suppressor	62,481	0*	0*
060513	Dust Cap	62,481	0	0
060514	Distributor Assembly	62,481	6	9.60
0607	Engine Control Panel	61,731	1*	1.62*
06071	Ammeter	61,731	0	0
06072	Fuel Gage	61,731	3	4.86
06073	Oil Pressure Gage	61,731	7	11.34
06074	Hour-Meter	61,731	14	22.68
06075	Temperature Gage	61,731	4	6.48
06076	Light Switch	61,731	7	11.34
06077	Transmission Oil Switch	61,731	0	0
06078	Ignition Switch	62,481	8	12.80
06079	Starter Switch	62,481	19	30.41
060710	Fuse, Holder, Block	62,481	10	16.00
060711	Divider (Insulator)	62,481	2	3.20
0609	Lights	15,620	6*	38.41*
06091	Headlight	15,620	20	128.04
06092	Tail Light	15,620	26	166.45
06093	Wiring	15,620	2	12.80
06094	Mountings	15,620	0	0
06095	Seal Beam	15,620	15	96.03
06096	Bulbs	15,620	43	275.29
0610	Sending Units	61,731	0*	0*
06101	Hour-Meter	61,731	2	3.24
06102	Oil Pressure SU	61,731	3	4.86
06103	Water Temperature SU	61,731	3	4.86
06104	Fuel Gage SU	61,731	2	3.24
06105	Transmission Oil Temperature	61,731	1	1.62
06106	Fuel Tank SU	61,731	0	0
06107	Transmission Oil Temperature SU	61,731	0	0

*See important note on Appendix cover sheet

6000 POUND FORK-LIFT TRUCK FAILURE RATE DATA

Functional Group Code	Part Name	Operating Hours	Number of Failures	Failures/ 10^5 Hours
0611	Horn Assembly	1,312	10*	762.19*
06111	Button Spring	1,312	0	0
06112	Horn	1,312	2	152.44
06113	Cable	1,312	0	0
06114	Button Cover	1,312	0	0
06115	Contact	1,312	1	76.22
06116	Horn Button Kit	1,312	4	304.88
06117	Relay	1,312	1	76.22
0612	Storage Battery	62,481	39*	62.42*
06121	Cell	62,481	0	0
06122	Terminal	62,481	1	1.60
06123	Cable	62,481	5	8.00
06124	Cap	62,481	0	0
06125	Frame, Fitting, Etc.	62,481	2	3.20
0613	Chassis Wiring Harness	62,481	0*	0*
06131	Connectors	62,481	0	0
06132	Wire	62,481	11	17.61
0710	Transmission Assembly	29,741	9*	30.26*
07101	Gears	29,741	0	0
07102	Bearing	29,741	2	6.72
07103	Seal	29,741	7	23.54
07104	Screen	29,741	0	0
07105	Gasket	29,741	4	13.45
07106	Hoses	29,741	1	3.36
07107	Bracket	29,741	0	0
07108	Retainer Ring	29,741	9	30.26
071010	Neutral Switch	29,741	5	16.81

*See important note on Appendix cover sheet

6000 POUND FORK-LIFT TRUCK FAILURE RATE DATA				
Functional Group Code	Part Name	Operating Hours	Number of Failures	Failures/ 10^5 Hours
0713	Intermediate Clutch	29,741	0*	0*
07131	Gears	29,741	0	0
07132	Seal	29,741	2	6.72
07133	Bearings	29,741	3	10.09
07134	Piston	29,741	0	0
07135	Clutch Spring	29,741	0	0
0714	Servo Unit	29,741	0*	0*
07141	Control Knob	29,741	1	3.36
07142	Linkage	29,741	6	20.17
07143	Plug	29,741	0	0
07144	Valve Spring	29,741	0	0
07145	Seal	29,741	3	10.09
07146	Gasket	29,741	0	0
07147	Plunger	29,741	0	0
07148	Valve	29,741	2	6.72
07149	Tube	29,741	0	0
0721	Coolers, Pumps, Motors	29,741	4*	13.45*
07211	Filter Element	29,741	0	0
07212	Gasket	29,741	0	0
07213	Relief Valve	29,741	0	0
07214	Filter Spring	29,741	0	0
07215	Plug	29,741	0	0
07216	Hose, Fittings	29,741	1	3.36
0900	Propeller and Shaft Assembly	29,741	2*	6.72*
09001	Bolts	29,741	0	0
09002	Bearings	29,741	2	6.72
09003	Shaft	29,741	2	6.72
09004	Sprocket	29,741	0	0
09005	"U" Joint Kit	29,741	1	3.36
09006	"U" Joint Assembly	29,741	3	10.09

*See important note on Appendix cover sheet

6000 POUND FORK-LIFT TRUCK FAILURE RATE DATA

Functional Group Code	Part Name	Operating Hours	Number of Failures	Failures/ 10^5 Hours
1000	Axle and Housing	29,741	3*	10.09*
10001	Shaft	29,741	1	3.36
10002	Housing	29,741	0	0
1002	Differential	29,741	3*	10.09*
10021	Roller Bearing(2)	29,741	0	0
10022	Ring Gear/Pinion Teeth	29,741	0	0
10023	Spider Gear (2)	29,741	0	0
10024	Gasket(26)	29,741	1	3.36
10025	Carrier	29,741	0	0
10026	Seal	29,741	1	3.36
10027	Cone (2)	29,741	0	0
1100	Rear Axle Assembly	29,741	0*	0*
1104	Steering Sideshaft and Wheel Leaning Mechanism	29,741	5*	16.81*
11041	Steering Axle	29,741	6	20.17
11042	King Pin Bearing(2)	29,741	7	23.54
11043	King Pin (2)	29,741	20	67.25
11044	Fitting	29,741	8	26.90
11045	Bushing	29,741	27	90.78
11046	Steering Center Arm	29,741	16	53.80
11047	Cone and Roller	29,741	12	40.35
11048	Roller Bearing	29,741	30	100.87
11049	Cup	29,741	13	43.71
110410	Seal	29,741	4	13.45
1204	Hydraulic Brake System	61,731	0*	0*
12041	Hydraulic Brake Line	61,731	0	0
12042	Gasket	61,731	2	3.24
12043	Wheel Cylinder Boot (2)	61,731	3	4.86
12044	Cup and Piston (2)	61,731	4	6.48

1204 CONTINUED ON NEXT PAGE

See important note on Appendix cover sheet

6000 POUND FORK-LIFT TRUCK FAILURE RATE DATA				
Functional Group Code	Part Name	Operating Hours	Number of Failures	Failures/ 10^5 Hours
12045	Master Cylinder Cup Seal (2)	61,731	0*	0*
12046	Master Cylinder Piston (2)	61,731	0	0
12047	Master Cylinder Spring (2)	61,731	0	0
12048	Hose	61,731	0	0
12049	Tank Fitting	61,731	0	0
120410	Master Cylinder Assembly (2)	61,731	7	11.34
120411	Wheel Cylinder Kit (2)	61,731	0	0
120412	Master Cylinder Kit (2)	61,731	5	8.10
120413	Inching Valve Boot (2)	3,343	0	0
120414	Inching Valve Assembly (2)	3,343	1	29.91
1206	Mechanical Brake	61,731	0*	0*
12061	Pedal Pad	61,731	20	32.40
12062	Return Spring	61,731	1	1.62
12063	Linkage	61,731	2	3.24
12064	Bearing	61,731	0	0
1201	Hand Brake	61,731	18*	29.16*
12011	Shear Pin	61,731	0	0
12012	Cable and Clamp	61,731	7	11.34
12013	Lever	61,731	8	12.96
12014	Knob	61,731	2	3.24
12015	Shoes/Band	61,731	1	1.62
1202	Service Brake	61,731	58*	93.96*
12021	Brake Shoe	61,731	58	93.96
12022	Retracting Spring (2)	61,731	7	11.34
12023	Brake Lining (4)	61,731	0	0
12024	Carrier Plate	61,731	0	0
12025	Adjusting Screw	61,731	0	0
12026	Wheel Cylinder Assembly	61,731	2	3.24
12027	Cable Assembly	61,731	7	11.34
12028	Seals	61,731	7	11.34
12029	Creeper/Inching Pedal	3,343	10	299.13
12030	Clamp	61,731	0	0

*See note on Appendix cover sheet

6000 POUND FORK-LIFT TRUCK FAILURE RATE DATA

Functional Group Code	Part Name	Operating Hours	Number of Failures	Failures/ 10^5 Hours
1311	Wheel Assembly	59,482	5*	8.40*
13111	Brake Drum	59,482	5	8.40
13112	Wheel Bearing	59,482	1	1.68
13113	Cup(4)	59,482	0	0
13114	Wheel Nuts, Bolts, Lugs	59,482	31	52.12
13115	Seal	59,482	7	11.77
13118	Spring	59,482	0	0
13131	Tires(6)	59,482	201*	337.92*
13132	Tubes(6)	59,482	34	57.16
1401	Mechanical Steering Assembly	29,741	2*	6.72*
14011	Tie Rod and End	29,741	28	94.15
14012	Bearing	29,741	3	10.09
14013	Steering Wheel	29,741	1	3.36
14014	Seal	29,741	2	6.72
14015	Shaft	29,741	2	6.72
14017	Drag Link	29,741	19	63.88
14018	Nuts, Bolts, Etc.	29,741	38	127.77
1411	Hoses, Lines and Fittings	29,741	12*	40.35*
1412	Hydraulic Cylinder	29,741	31*	104.23*
14121	Seal	29,741	1	3.36
14122	Cylinder	29,741	0	0
14123	Piston	29,741	1	3.36
14124	Ball Socket	29,741	19	63.88
1501	Frame Assembly	59,482	14*	23.53*

*See important note on Appendix cover sheet

6000 POUND FORK-LIFT TRUCK FAILURE RATE DATA				
Functional Group Code	Part Name	Operating Hours	Number of Failures	Failures/ 10^5 Hours
1502	Counterweight	59,482	1*	1.68*
1801	Body Assembly	59,482	1*	1.68*
18011	Hinge	59,482	0	0
18012	Latch	59,482	1	1.68
18013	Structure	59,482	26	43.71
18015	Floor Board Assembly	59,482	1	1.68
18062	Seat Back Rest	62,481	10*	16.00*
2401	Hydraulic Lift Pump	29,741	11*	36.98*
24011	Pump Drive Cross Bearings	29,741	0	0
24012	Pump Bearings	29,741	2	6.72
24013	Seal	29,741	0	0
24014	Gear	29,741	0	0
24015	Pump Packing	29,741	3	10.09
2402	Hydraulic Control Valve	29,741	15*	50.44*
24021	Spring	29,741	1	3.36
24022	Seal(2)	29,741	13	43.71
24023	Piston	29,741	0	0
24024	Cap	29,741	1	3.36
24025	Hose	29,741	3	10.09
24026	Bracket	29,741	0	0
24028	C/V Packing	29,741	2	6.72
24029	C/V Ring Set	29,741	0	0

*See important note on Appendix cover sheet

6000 POUND FORK-LIFT TRUCK FAILURE RATE DATA

Functional Group Code	Part Name	Operating Hours	Number of Failures	Failures/ 10^5 Hours
2403	Hydraulic Controls Levers Linkage	29,741	3*	10.09*
24032	Linkage Pin	29,741	0	0
24033	Level, Link or Rod	29,741	4	13.45
2404	Hydraulic Tilt Cylinder	29,741	10*	33.62*
24041	Packing	29,741	9	30.26
24042	Tilt Cylinder Assembly	29,741	2	6.72
24043	Linkage	29,741	1	3.36
24044	Packing Nut	29,741	1	3.36
24045	Hose	29,741	2	6.72
24046	Ring	29,741	1	3.36
24047	Cup	29,741	0	0
24048	Kit	29,741	5	16.81
2405	Hydraulic Mast Column Assembly	59,482	3*	5.04*
24051	Packing, Lift Cylinder	59,482	14	23.54
24052	Cylinder	59,482	8	13.45
24053	Roller Bearings (2)	59,482	0	0
24055	Chain (2)	59,482	6	10.09
24056	Package Rack	59,482	35	58.84
24057	Ring	59,482	4	6.72
24058	Inner Slide	59,482	3	5.04
24059	Brace	59,482	0	0
240511	Flange Assembly	59,482	0	0
240512	Bolt, Clamp	59,482	2	3.36
240513	Packing Nut	59,482	0	0
240514	Forks	59,482	2	3.36
2406	Hydraulic Lines and Fittings	59,482	0*	0*
24061	Lines	59,482	9	15.13
24062	Filter Element	59,482	4	6.72
24063	Filter Gasket	59,482	0	0
24064	Filter Spring	59,482	0	0
24065	Hydraulic Fluid Tank	59,482	5	8.40

*See important note on Appendix cover sheet